Predictors of Academic Difficulties of Osteopathic Medical Students in the Preclinical Curriculum

A Thesis

Presented to

the School of Education

Drake University

In Partial Fulfillment

of the Requirements for the Degree

Specialist in Education

by Margaret Susan Cigelman

August 1993

Predictors of Academic Difficulties of Osteopathic Medical Students in the Preclinical Curriculum

by Margaret Susan Cigelman

August 1993

Approved by Committee:

Thomas S. Westbrook

Robert L. Hoehle

Richard L. Schwab
Dean of the School of Education

Predictors of Academic Difficulties of Osteopathic Medical Students in the Preclinical Curriculum

An abstract of a Thesis by
Margaret Susan Cigelman
August 1993
Drake University
Advisor: Thomas S. Westbrook

The problem. This research examined the relationship of admission characteristics with indicators of academic performance during the first year of an osteopathic medical curriculum. This was done in order to identify factors that might suggest that osteopathic students will experience academic difficulties early in their enrollment.

Procedures. Ex post facto research in the form of a retrospective correlational study was conducted. Admission and grade records were reviewed for 50 students who had two or more course failures during the first year of the curriculum and 50 students who had no course failures during the same period. Correlation coefficients and coefficients of determination were calculated for the relationships of the number of course failures and eight admission variables. The same procedure was used between each of the admission variables and the first year grade point average.

Findings. There were statistically significant but low negative correlations between each of the eight admission variables and the number of course failures. There were statistically significant but low positive correlations with the first year grade point average. The admission variables explained 30 percent of the variability in the number of course failures or first year grade point average.

Conclusions and Recommendations. The admission characteristics were individually of limited value in predicting performance during the first year preclinical curriculum of an osteopathic medical school. Future research needs to expand the variables for study. Studies done at individual institutions should not only look at traditional predictors, but should also look at variables that are unique to their applicant pool and their institutions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Page

Chapter 1

INTRODUCTION

Background of the Study

There have been a number of studies conducted as to the predictive validity of medical school admission criteria. Most of these studies have been completed at non-osteopathic schools of medicine. It has been found that admission criteria have variable value in predicting either academic or clinical success (Hart, Payne, & Lewis, 1981; Hendren, 1988; Inglehart & Brown, 1990; Jones & Mitchell, 1986; Jones & Vanyur, 1984; Keill & Willer, 1983; Mitchell, 1990). There are medical students that meet admission criteria and still experience academic difficulties. These students may take longer than normal to complete medical school or may be dismissed from school. It would be of benefit to medical school administrators, faculty, and students if these students could be identified early in their enrollment so that appropriate intervention could occur to minimize academic problems.

Studies of medical school admission criteria have investigated such factors as the relationship of Medical

College Admission Test (MCAT) scores (Jones & Thomae-Forgues, 1984), undergraduate grade point average (Mitchell, 1990), institutional selectivity (Hall & Bailey, 1992), type of undergraduate degree (Koenig, 1992), and nonacademic characteristics. Other factors that may be significant are age, number of undergraduate institutions attended, length of time for completion of undergraduate degree, length of time since completion of degree, etc.

Studies of medical school admission criteria have for the most part been school specific and different variables were predictive from school to school (Arnold & Mares, 1985; Bridgham, 1990; Colliver, Verhulst, & Williams, 1989; Hall & Bailey, 1992; Hart, Payne, & Lewis, 1981; Hendren, 1988; Jackson & Dawson-Saunders, 1987; Jackson & Brooks, 1985). Single site researchers called for more multiple site studies (Hall & Bailey, 1992; Jackson & Dawson-Saunders, 1987; Jackson & Brooks, 1985; Mitchell, 1990) while multiple site researchers did just the opposite (Jones & Mitchell, 1986; Jones & Thomae-Forgues, 1984; Jones & Vanyur, 1984). Researchers called for studies on how exceptions to the trends related to specific characteristics of a particular school in terms of

applicant pools, curriculum, and the nature of their performance measures (Mitchell, 1987).

The faculty and administration of the College of Osteopathic Medicine and Surgery of the University of Osteopathic Medicine and Health Sciences in Des Moines, Iowa had been concerned about the rate of course failures in the first year of the osteopathic curriculum. An ad hoc committee was formed to study student performance and the first area of study was admission criteria. A review of literature on this topic revealed that the MCAT appeared to be the most reliable individual predictor of medical school performance in the preclinical curriculum. Opinions solicited from the Director of Admissions and basic science faculty revealed that the variables they felt were most important as determinants of success in the preclinical curriculum would be indicated through subtests of the MCAT (Science Problems and Skills Analysis: Reading) and the student's undergraduate science grade point average (GPA). A review of literature revealed a scarcity of information on the predictive validity of medical school admission criteria in schools of osteopathic medicine. The literature also related that exceptions to predictive trends often

relate to specific characteristics of a school. For these reasons, a study specific to the College of Osteopathic Medicine and Surgery was undertaken by the researcher.

Purpose of the Study

The study was designed to determine if there were common characteristics in admissions criteria among students who had academic difficulties in the first year preclinical curriculum of an osteopathic medical school. This was done in order to identify osteopathic students who may experience academic difficulties early in their enrollment. A review of admission records and academic grade records of first year courses, for the Classes of 1990, 1991, 1992, 1993, and 1994 of the College of Osteopathic Medicine and Surgery, was undertaken to determine the relationship between number of course failures during the first year with the following independent variables: (a) MCAT Biology Subtest, (b) MCAT Chemistry Subtest. (c) MCAT Physics Subtest, (d) MCAT Science Problems Subtest, (e) MCAT Skills Analysis: Reading, (f) MCAT Skills Analysis: Quantitative, (g) undergraduate cumulative GPA, and (h) undergraduate science GPA. The same

analysis was performed on the relationship of the first year GPA with these same variables.

Statement of the Problem

This study examined the relationship of admission characteristics with indicators of academic performance during the first year of an osteopathic medical curriculum. The research question was: Are there common admission characteristics among students who have academic difficulties in the first year preclinical curriculum of an osteopathic medical school?

Research Hypotheses

The specific research hypotheses for this study were:

1. There is a correlation between the number of course failures during the first year preclinical curriculum and each MCAT subtest, the undergraduate cumulative GPA, and the undergraduate science GPA.

2. There is a correlation between the first year GPA and each MCAT subtest, the undergraduate cumulative GPA, and the undergraduate science GPA.

Null Hypotheses

The study tested the following null hypotheses:

1. There is no correlation between the number of course failures during the first year preclinical

curriculum and each of the MCAT subtests, the undergraduate cumulative GPA, and the undergraduate science GPA.

2. There is no correlation between the first year GPA and each of the MCAT subtests, the undergraduate cumulative GPA, and the undergraduate science GPA.

Significance of Study

This was a correlational study using a non-experimental ex post facto design. The study explored the relationship between admission characteristics and academic performance in the first year preclinical curriculum of an osteopathic medical school. The results of this study will guide administrators and faculty within the College of Osteopathic Medicine and Surgery in further research and in their identification of students who meet admission criteria but may experience academic difficulties in the preclinical curriculum. These students will be placed in appropriate programs of academic counseling and tutoring from the time of initial enrollment. Other colleges of osteopathic medicine may also benefit from this information as little research has been done at osteopathic colleges. This same study could be easily

duplicated at other institutions and comparisons made between osteopathic and non-osteopathic institutions.

Delimitations of Study

In this study, the sample was delimited to students in five classes of an osteopathic medical school. Generalizations beyond these five classes or to other osteopathic schools should be made with care.

The accessible population from which the random sampling occurred was reduced by the fact that complete admission data was not available on all of the students. Internal validity may also have been reduced due to threats of maturation and history. The subjects in this study could have undergone physiological or psychological changes during the first year preclinical curriculum due to such factors as the stress that occurs during the first year of medical school. External influences, such as environmental factors during testing sessions, could have also affected the results of this study.

Assumptions

Assumptions made for this study were:

1. The admission records, course grade records, and lists of class rankings were accurate reports of the students' admission variables and academic performance;

2. The Medical College Admission Test was a reliable and valid testing instrument (New MCAT, 1977); and

3. The variables were recorded accurately by the researcher.

Definition of Terms

First year preclinical curriculum courses include: anatomy, basic histology, biochemistry, microbiology/ immunology/virology, introduction to physiology and pharmacology, behavioral science/ behavioral medicine, radiology, general pathology, neuroanatomy, physical diagnosis I, human development, and osteopathic manipulative medicine I.

Failing grade is any numerical grade recorded on a student's record that is less than 70 percent.

Class rank refers to the numerical standing of each student within a class determined by the student's cumulative grade point average.

Cumulative first year grade point average (GPA1) is the grade point average taking into account all courses during the first year of the curriculum. It is expressed as a percentage based on 100 points.

Undergraduate grade point average (GPACum) is the average grade point combining coursework from all

undergraduate institutions in which the student has been in enrollment. It is expressed as a number on a four point scale.

Undergraduate science grade point average (GPASci) is the average of all courses in the physical sciences, natural sciences, and mathematics. It is expressed as a number on a four point scale.

Medical College Admission Test (New MCAT, 1977) is an examination developed to measure the medical school applicant's academic preparation to undertake the study and eventual practice of medicine.

The MCAT (New MCAT, 1977) utilized with the students in this study was comprised of six areas of evaluation. Each area is scored as a whole number on a scale of 1 to 15. These areas were:

Science Knowledge in Biology (Bio), Chemistry (Chem), and Physics (Phys) reflects an individual's level of mastery of medically relevant scientific principles in the individual science domains. Successful performance requires the recall of facts, definitions and relationships and the application of single facts, concepts, and principles to identify solutions or reach a conclusion in a familiar scientific situation.

Science Problems (SciProb) includes topics of general medical relevance presented as longer exercises. Successful performance requires the ability to integrate several of the principles tested in the Science Knowledge subtests and to apply these principles to solve problems in novel and generally medically relevant situations.

Skills Analysis: Reading (Read) and Quantitative (Quant) are designed to assess individual ability and skills in gathering, analyzing, evaluating, and using information. A mixture of topics is intended to reflect the diversity of issues with which the medical student and physician are expected to be conversant.

Chapter 2

REVIEW OF THE LITERATURE

Introduction

Research in the area of the predictive validity of medical school admission criteria has been conducted since at least the 1950's. Due to the wealth of publications in this area, the researcher chose to limit the literature review primarily to studies published over the past ten years. This also aided in eliminating studies of admission tests and criteria that are no longer utilized by medical schools.

A total of 36 articles were found for this review. Five of the articles were not used as they were not reports of primary research. Eight articles were related to the topic but did not specifically speak to experiences of medical students in the preclinical curriculum. Primary topics for these articles were comparisons of admitted and non-admitted applicants to medical school and follow-up studies of medical school graduates.

The final review consisted of 23 articles primarily from the Journal of Medical Education and Academic

Medicine. The articles were analyzed utilizing descriptive statistics and several of the correlational studies were also analyzed by looking at practical significance.

Results

General

Seventeen of the studies reported single site studies while six articles dealt with multiple site studies as illustrated by Table 1 and Table 2. All of the studies used medical students as the sample except one study utilized pharmacy students and one used dental students. Sample sizes for the 17 single site studies ranged from 21-1,156 with a mean of 243. The mode, as represented in Figure 1, was the category of sample size from 0-100 with a frequency of eight.

Validity

As evidenced by Table 1 and Table 2, the primary threats to internal validity in many of the studies were in the areas of maturation and history. The researcher viewed these as moderate threats as each study measured academic performance of medical students at least one year after criteria for admission had been submitted by each student. Medical students can experience a number of internal and external stressors that can influence

Table 1

Single Site Research Studies

Study	Sample	Sample Size	Threats to Validity*	Research Design
Arnold 1985	Medical students	21	S,I,	Interviews
Bridgham 1990	Medical students	93	Ma,Mo,H	Correlation
Colliver 1989	Medical students	137	Ma,Mo,H	Correlation
Daugherty 1990	Medical students	478	Ma,H	Causal-comparative
Hall 1992	Medical students	410	Ma,H	Correlation
Hart 1981	Medical students	172	Ma,H	Correlation
Hendren 1988	Medical students	41	Ma,S,I,H	Causal-comparative
Inglehart 1990	Medical students	1156	Ma,H	Correlation
Jackson, J. 1985	Medical students	292	Ma,H	Correlation
Jackson, E. 1987	Medical students	41	Ma,S,H	Correlation
Jackson, J. 1989	Medical students	399	Ma,S,H	Causal-comparative
Keill 1985	Medical students	27	Ma,I,H	Causal-comparative
Kerbeshian 1989	Medical students	53	Ma,S,I,H	Correlation
Solander 1978	Pharmacy students	65	Ma,H	Correlation
Strayhorn 1989	Medical students	442	Ma,Mo,I,H	Causal-comparative
Walker 1985	Pharmacy students	93	Ma,H	Correlation
Zeleznik 1983	Medical students	200	Ma,S,I,H	Causal-comparative

*Threats to Validity: H=History; I=Instrumentation; Ma=Maturation; Mo=Mortality; S=Selection

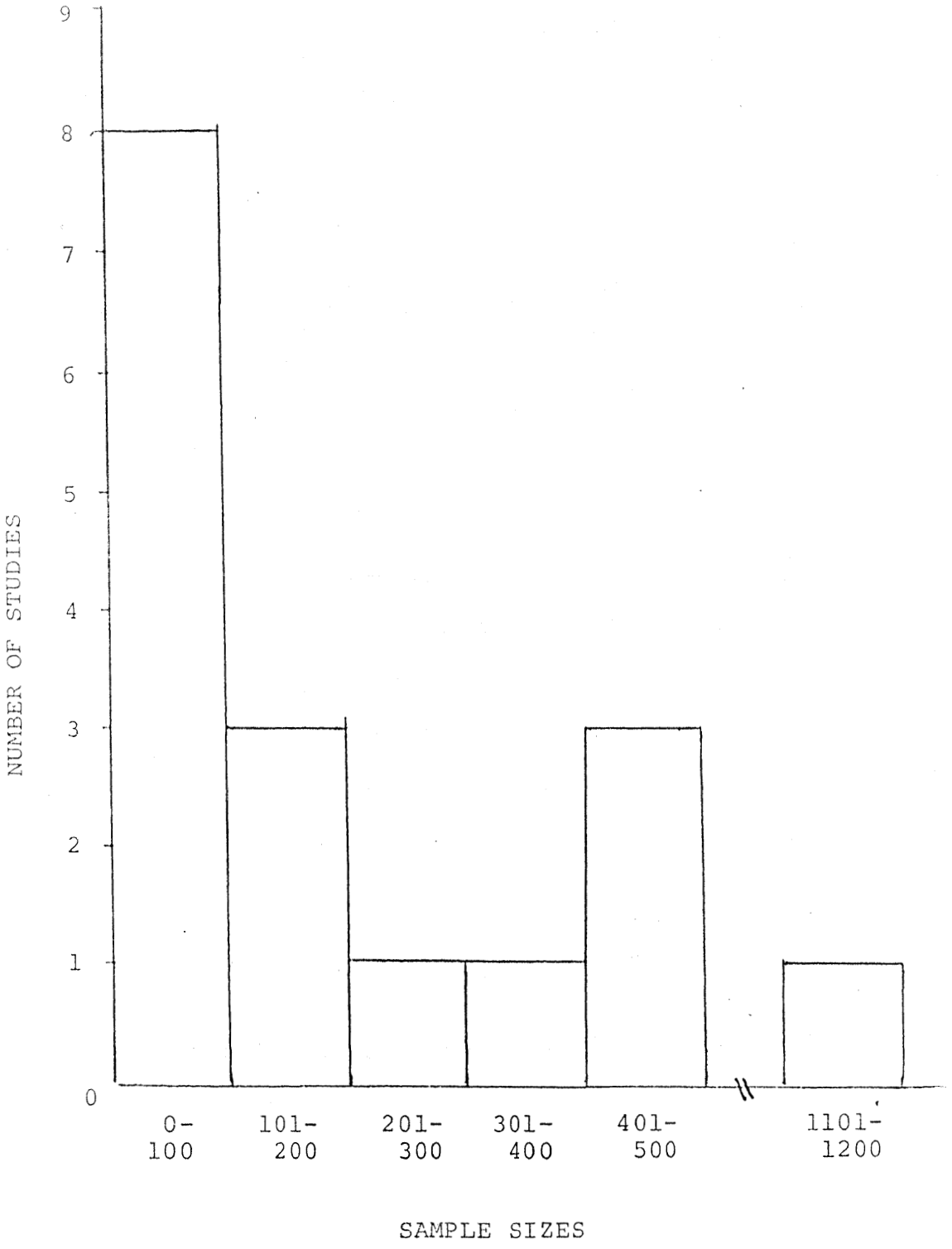
Table 2

Multiple Site Research Studies

Study	Sample	Sample Size	Threats to Validity*	Research Design
Jones & Mitchell 1986	Medical students	27,828	Ma,S,Mo,H	Correlation
Jones & Thomae-Forgues 1984	Medical students	20 classes	Ma,Mo,H	Correlation
Jones & Vanyur 1984	Medical students	31,339	Ma,S,Mo,H	Correlation
Koenig 1992	Medical students	Random Smpl 132/15,914	Ma,S,I,H	Causal-comparative
Mitchell 1987	Admission officers	113 schools	Mo,I,H	Survey

*Threats to Validity: H=History; I=Instrumentation; Ma=Maturation; Mo=Mortality; S=Selection

Figure 1. Sample sizes of single site studies.



their reactions and performance.

External validity ranged from being a strong threat to a weak threat. A couple of authors (Jackson & Brooks, 1985; Hall & Bailey, 1992) noted that their studies lacked the ability to generalize and lacked range. Medical schools had much in common but each was unique in its approach to admissions, curriculum, and measurement of academic performance. Thus, the single site studies tended to be weak in external validity while the multiple site studies tended to have stronger external validity.

Research Designs

Thirteen of the twenty-three studies used a correlational research design while another seven utilized a causal-comparative design. There was also one survey study and one interview study. The majority of the studies took one or a number of medical school admission criteria and correlated these criteria with indicators of academic performance during medical school.

Predictors

GPA and MCAT scores. Mitchell (1990) in a meta analysis of articles dealing with predictors of academic difficulties of medical students stated that

GPA, MCAT scores and selectivity information predict well the medical student's performance in the basic sciences. The Medical College Admission Test (MCAT) and undergraduate grade point average (GPA) are the two admission criteria that are most commonly used by medical schools.

Several of the correlational studies that dealt with the MCAT and GPA lent themselves to analyzing practical significance. Table 3 demonstrates the capacity of MCAT scores and GPA to explain the variability of first year grades, second year grades, and NBME I scores.

MCAT scores had the capacity to explain from 11-22 percent of the variability of first year grades. The MCAT science subtest had the capacity to explain from 18-27 percent of the variability of NBME I scores. Overall undergraduate GPA had the capacity to explain 6.3-29.0 percent of the variability of NBME I scores. Studies by Colliver, Verhulst, and Williams (1989) and Jones and Thomae-Forgues (1984) supported the MCAT as a predictive measure especially in relation to the NBME I. Jones and Thomae-Forgues (1984) and Hall and Bailey (1992) found that higher MCAT scores were associated with higher grades in Year I, especially in biochemistry

Table 3

Practical Significance (r^2)

Study	Admissions	Year I GPA	Year II GPA	NBME I Scores
Bridgham 1990	MCAT Science			27%
	Total GPA			14%
Colliver 1989	MCAT Total			37-44%
	MCAT Science			23-24%
	MCAT Reading			14-23%
	Total GPA			17-29%
	Science GPA			19-34%
Hall 1992	MCAT Subtests	11-22%		
	Science GPA	4.9-13%		
Hart 1981	Science GPA	Memory learning Biochem/16% Physiology/15.2%		
	MCAT Biology	Physiology/15.2%		
	MCAT Chem & Quant	Biochem/6.8%		
	Science GPA	Higher Learning Biochem/18.5%		
	MCAT Science & Quant	Biochem/8.4-11.6%		
	MCAT Chem & Quant	Physiology/ 20.3-25%		
Jackson 1985	NDRT	7.8%		
	MCAT Reading	4.4%		
Jones 1984	MCAT Science	9.6%	4.8%	18%
	MCAT Reading	3.6%	4.4%	5.8%
	Total GPA	14%	12%	6.3%
	Science GPA	13%	12%	8.4%
Walker 1985	Interview	1.4%	2.3%	

and physiology. Correlations between MCAT subtest scores and Year II grades were shown by Jones and Thomae-Forgues (1984) to be weak to moderate.

Hendren (1988) studied 41 medical students at risk for academic dismissal. These students were found to have lower MCAT scores and GPA. The competitiveness of their undergraduate schools did not make a difference. Hall and Bailey (1992) also found the MCAT to be a valuable leveler in the assessment of students from diverse undergraduate schools.

In another study by Jones and Vanyur (1984), a positive relationship was found between performance on the MCAT and graduating on time. For those students scoring below an eight on the MCAT chemistry or reading subtest, the probability of encountering academic problems increased as scores decreased.

Hart, Payne, and Lewis (1981) studied science GPA and MCAT scores and their relationship to different types of learning. The authors found that cognitive style seemed to have little practical significance as a predictor of preclinical performance. They also found that the variables were differentially predictive in different courses and at different levels of learning within the same course.

Bridgham (1990), besides correlating GPA and MCAT scores with NBME I results, also studied the effect of combined factors on the number of no credit course grades given to medical students. The author found that the number of unfinished undergraduate credits correlated strongly with the time it took to complete the preclinical curriculum. The undergraduate GPA was found to be the best single predictor of the number of no credit grades received in the preclinical curriculum.

Interview. The admission interview was another area of study. Walker, Killip, and Fuller (1985), in a study of dental students, concluded that there was a lack of significant correlations between the interview and academic performance in the preclinical curriculum. Daugherty, Eckenfels, and Schmidt (1990) compared the predictive capacity of admission committee dissent and academic predictors. The author found that students who dropped out or dropped back were significantly more likely to have received less than 100 percent of the votes for admission.

Types of degrees. In a study by Zeleznik, Hojat, and Veloski (1983), four types of undergraduate degrees were analyzed to determine what effects they had on

academic performance. These degrees were B.A. in Social Sciences, B.A. in Humanities, B.A. in Science, and B.S. in Science. The authors found no significant differences in first and second year GPA, NBME I scores, delayed graduation, and attrition between the four types of degrees. Koenig (1992) in a multiple site study found no significant difference between broad and science-focused preparation in rate of academic difficulty.

Nonacademic. In an interview study, Arnold and Mares (1985) conducted exit interviews with 22 students who had left medical school. Sixteen had left due to poor academic standing. Of these sixteen, half were female, most were from an urban area, and most were Caucasian. In a review of these students' admissions files, several indicators were noted that could have served as predictors of problems. These included references, interest inventory scores, comments of interviewers, and test scores.

In the area of interest in medicine, Inglehart and Brown (1990) found that the more medical students chose a medical career because of their parents, the worse their achievements in medical school. The more highly a student was focused on becoming an M.D., the better

his/her scores on the NBME I. The author concluded that considering a person's sense of professional identity could be seen as a useful predictor of achievement.

Keill and Willer (1983) studied 27 medical students that had been found to be psychiatrically disturbed. Males outnumbered females and there were more majority students than minority students. These students were more likely to have attended more than one undergraduate college. Other demographic variables were not found to be significant.

Reapplicants. In a study of reapplicants who had been admitted to medical school, Jackson, Brooks, Brown, and Scott (1989) found that preadmission measures alone predicted 12.8 percent of the variance in academic difficulty. The fact that the student was a reapplicant added nothing to the prediction of academic difficulty.

Minorities. Studies on minority admissions brings forth another set of questions. Strayhorn and Frierson (1989) in a study of both black and white students found different predictors of performance. The two predictors for black students were the mean MCAT of all students from their college who took the MCAT the same year and the individual student's mean MCAT. Seven predictors were found for white students.

They were: hometown size, undergraduate school's mean MCAT, science GPA, student's mean MCAT, active coping, perceived mental well-being, and perceived quality of the learning environment. For both, the individual mean MCAT was the strongest predictor.

In a study by Jones and Mitchell (1986), which looked at all black and white students who entered medical school in 1978 and 1979, it was found that 4.7 percent of the white students had academic difficulty and 28.5 percent of the blacks had academic problems. The study showed that both black and white students who had MCAT scores below eight had an increasing probability of academic difficulty. The probability of academic difficulty for blacks was higher at all score levels.

Jackson and Dawson-Saunders (1987) reported that students who experienced difficulty had lower GPA and MCAT scores regardless of being a minority or majority. Significant variables for minorities were found to be science GPA, MCAT reading subtest, and the number of withdrawals from undergraduate classes. Significant predictive variables for majority students were MCAT biology subtest and number of incompletes during undergraduate classes. It was also found that students

who succeeded in the first year had a lower incidence of withdrawals, repeated courses and incompletes during their undergraduate education.

Kerbeshian (1989) studied American Indian medical students. American Indian students who had dropped out of medical school were compared with those who had achieved graduation. The drop outs on the average were one year younger, had attended reservation schools, had a greater number of siblings, and fewer had children. Family responsibilities were one of the students' major areas of conflict.

Related studies. In a related study of pharmacy students, Solander (1978) identified six variables that provided optimal statistical separation of students into categories of trouble or success. These were a reading comprehension score, overall GPA, a chemistry score, gender, required courses GPA, and a verbal score. With a model using these variables, the author felt an admissions committee could identify, prior to admission, 68 percent of the students who entered the program and experienced academic difficulty.

Mitchell (1987) surveyed medical school admission officers to identify what they felt were the important variables to predict academic success or failure.

Variables of high importance were: overall and science undergraduate GPA's; quality of the undergraduate institution; letters of evaluation; interview ratings; MCAT scores; extracurricular activities; work related to health care; breadth and/or difficulty of coursework; and state of legal residence.

Conclusions

As noted in the introduction to this review, there have been a number of studies completed that have looked at a wide range of possible predictors of academic performance in medical school. This review examined a sample of these studies. Many of the studies showed small to moderate statistical correlations. Practical significance was low in most cases. The variables that would explain the other 70-80 percent of the variability of the performance measures were not apparent in these studies. There appeared to be low correlations between the interview and other measures of noncognitive variables and performance in the preclinical curriculum so these variables were not the answer.

Studies for the most part were school specific and variables were differentially predictive from school to school. Single site researchers called for more multiple site studies while multiple site researchers

did just the opposite. These researchers called for studies on how exceptions to the trends relate to specific characteristics of a particular school in terms of applicant pools, curriculum, and the nature of their performance measures.

The majority of the single site studies had weak external validity. The multiple site studies may have had more statistical power due to their large sample sizes but when it came to applying these results to individual institutions there seemed to be inconsistencies in the applicability of the results to these unique schools. At this point, external validity appeared to be much more of a threat than internal validity.

There may actually be no trends in the variables utilized as academic predictors. Due to the threats of maturation and history, each medical student with academic difficulties may have a unique set of variables that contributed to poor academic performance.

Within all of this confusion, there did seem to be one theme that ran through a large majority of the studies. This theme was that the MCAT appeared to be the most reliable individual predictor of medical school performance in the preclinical curriculum. As much as

some admission officials would like to downplay cognitive admission variables and upgrade noncognitive variables, the fact remains that the MCAT was a useful tool for predicting success in the first two years of medical school. This review did not attempt to identify the most useful tool for predicting success in the clinical years of medical school or how these tools interrelate.

Using the literature review as a foundation, the following chapter presents the procedures used in this study.

Chapter 3

PROCEDURES

Introduction

The purpose of this study was to determine if there were common characteristics in admission criteria among students who had academic difficulties in the first year preclinical curriculum of an osteopathic medical school. Ex post facto research in the form of a retrospective correlational study was conducted to test the hypotheses.

Sample Selection

This study utilized two groups of subjects. Both groups were selected from the graduation classes of 1990, 1991, 1992, 1993, and 1994 of the College of Osteopathic Medicine and Surgery of the University of Osteopathic Medicine and Health Sciences in Des Moines, Iowa. Class enrollments were 168, 164, 179, 172, and 188 students respectively.

This population was 70.5 percent male (median age 23.8 years) and 29.5 percent female (median age 23.7 years). Iowa residents had the largest percentage of admissions (18.3 percent). Minorities made up 16.7 percent of the admitted students. The majority of the

enrolled students had bachelor's degrees only (91.0 percent) with 42.8 percent of the students gaining degrees in biology. The average undergraduate GPA for this population was 3.13 with an undergraduate science GPA mean of 3.00. The mean MCAT subtest scores were Biology/7.4, Chemistry/6.4, Physics/6.8, Science Problems/6.6, Reading/6.4, and Quantitative/6.4.

Group one was comprised of 50 students who did not fail any courses during the first year preclinical curriculum. Group two was comprised of 50 students who had failed two or more courses during the same period of time as group one.

A review of first year course grades was undertaken to determine the two groups. Eighty-two students were identified as having failed two or more courses the first year. Of these 82, complete admission data was available on 63 of the students.

Sixty-three students who did not fail any courses during the first year of the preclinical curriculum were selected from the upper quartile of the class rankings. The number of these students selected from each of the five classes equalled the number of students in each class whom had failed two or more courses. Fifty students from each group were then randomly selected to

be a part of the study. This allowed the researcher the ability to draw inferences about the population parameters on the basis of the estimated sample values.

Collection of Data

Identical data was collected for groups one and two. Confidentiality of student records was maintained by reviewing records in a private location and identifying each student on all data collection materials by a number rather than by name. The code key connecting names to numbers was kept in a separate and secure location. Recording by random sampling numbers assured that the records were in no fixed order. No individual identification was used in the report of the data in this study.

From grade records housed in the Registrar's Office, the number of failures during the first year was determined for each student. Class ranking lists, maintained also by the Registrar's Office, were used to derive first year cumulative GPA's and to determine the upper quartile of each class. Data maintained by the Admissions Office for each incoming class was reviewed to collect each student's MCAT scores, undergraduate cumulative GPA and undergraduate science GPA.

All data from these sources were recorded on a chart constructed by the researcher to aid in the organization of the data for each student. The headings of the chart were: student identification number, number of failures, first year GPA, MCAT subtest scores (biology, chemistry, physics, science problems, reading and quantitative), undergraduate cumulative GPA, and undergraduate science GPA.

Data Analysis

The collected data were analyzed utilizing Release 7 Standard Version of Minitab for DOS computers. Descriptive statistics were run separately for group one and group two.

In order to determine the correlation between variables, two conditions had to be satisfied before calculating the correlation coefficients. First, the two variables to be correlated had to be paired observations. Second, the variables had to have a linear relationship. Scattergrams were plotted for each pair of variables to establish these linear relationships.

For null hypotheses 1 and 2, A Pearson Product Moment Correlation (r) was used to quantify the relationship between each of the independent variables

and the number of course failures. The same procedure was used between each of the independent variables and the first year GPA.

Each correlation coefficient was subjected to a test of significance using a table of critical values of *r*. The .05 level of significance was accepted for all data analysis. The correlation coefficients were also interpreted in terms of variance through the use of coefficients of determination.

Chapter 4

PRESENTATION OF DATA AND FINDINGS

Introduction

In this chapter, the data collected in the study are presented and analyzed. Descriptive statistics on groups one and two are presented first. Scattergrams are then presented to illustrate the linear relationship between each of the independent variables and the number of course failures. Scattergrams are also used to illustrate the linear relationships between each of the independent variables and the first year GPA. For null hypotheses 1 and 2, correlation coefficients (r) are presented for the relationships demonstrated in the scattergrams. Analyses of each correlation coefficient are reported using the critical values of r and coefficients of determination.

Descriptive Data

The mean, median, standard deviation and range were calculated for each of the variables in group one and for each of the group two variables. This data is shown in Table 4. The mean number of failures in group two was 3.58 with a range of 2 to 7. The mean first year GPA for group one was 91.06 with a range

Table 4

Descriptive Statistics for Groups One and Two

Variable	Group	Mean	Median	sd	Range
# of failures	1	0.00	0.00	0.00	0-0
	2	3.58	3.00	1.40	2-7
GPA 1	1	91.06	90.58	1.70	88.32-94.97
	2	74.86	75.14	2.27	69.27-79.27
Biology	1	8.18	8.00	1.72	4-12
	2	5.62	6.00	2.13	1-12
Chemistry	1	7.48	7.50	1.83	4-11
	2	5.46	5.00	1.16	4-9
Physics	1	7.28	7.00	2.00	3-13
	2	5.68	5.00	1.57	3-10
Science Problems	1	7.42	7.00	1.72	5-13
	2	5.34	5.00	1.27	2-8
Reading	1	7.66	8.00	2.11	3-11
	2	5.54	5.00	2.22	1-11
Quantitative	1	7.24	7.00	1.89	4-12
	2	5.20	5.00	1.92	2-10
GPACum	1	3.27	3.21	0.33	2.71-3.97
	2	3.03	3.04	0.33	2.30-3.79
GPA Science	1	3.20	3.22	0.41	2.24-3.95
	2	2.90	2.89	0.36	2.18-3.68

of 88.32 to 94.97. The mean first year GPA for group two was 74.86 with a range of 69.27 to 79.27.

MCAT subtest means of group one ranged from 7.24 in Quantitative to 8.18 in Biology. Group two MCAT subtest means ranged from 5.20 (also in Quantitative) to 5.68 in Physics. There was no overlap in the ranges of the MCAT subtest means of the two groups.

The GPACum mean for group one was 3.27 with a range of 2.71 to 3.97 and the GPASci mean for this group was 3.20 with a range of 2.24 to 3.95. The GPACum mean for group two was 3.03 with a range of 2.30 to 3.79 and the GPASci mean for this group was 2.90 with a range of 2.18 to 3.68.

Null Hypothesis One

The scattergrams in Figures 2 through 9 illustrate the linear relationships between each of the independent variables and the number of course failures. The correlation coefficients between MCAT scores and number of course failures ranged from -.361 to -.500. These negative correlations indicated that as one variable increased the other variable decreased. See Table 5.

Figure 2. Scattergram of correlation of number of failures and biology subtest scores.

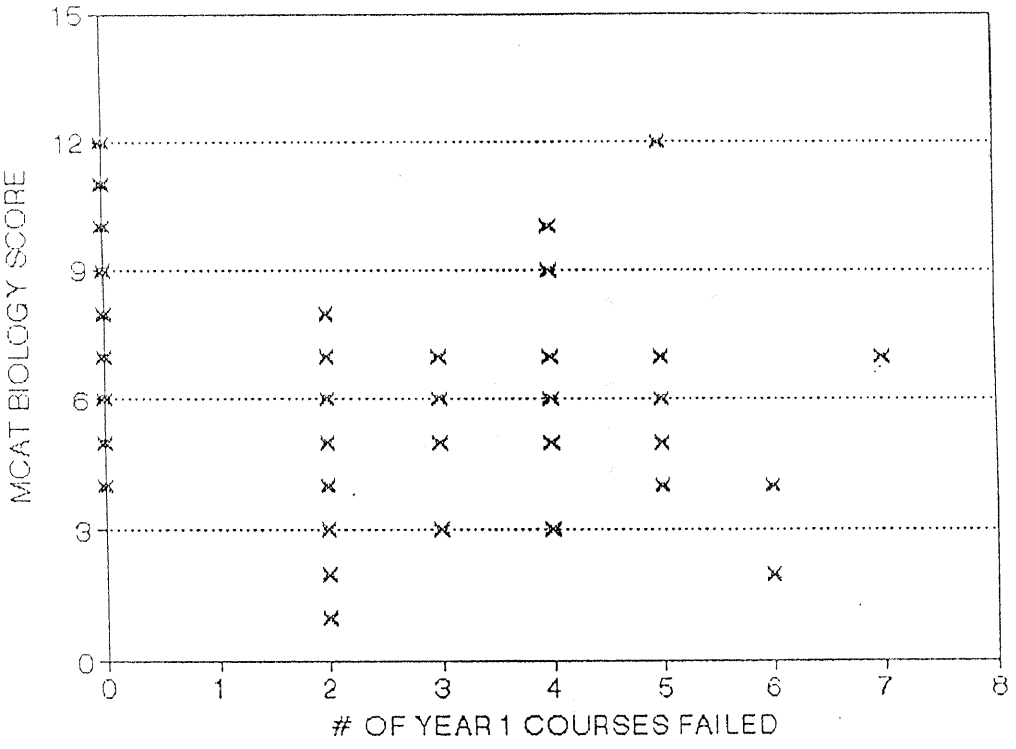


Figure 3. Scattergram of correlation of number of failures and chemistry subtest scores.

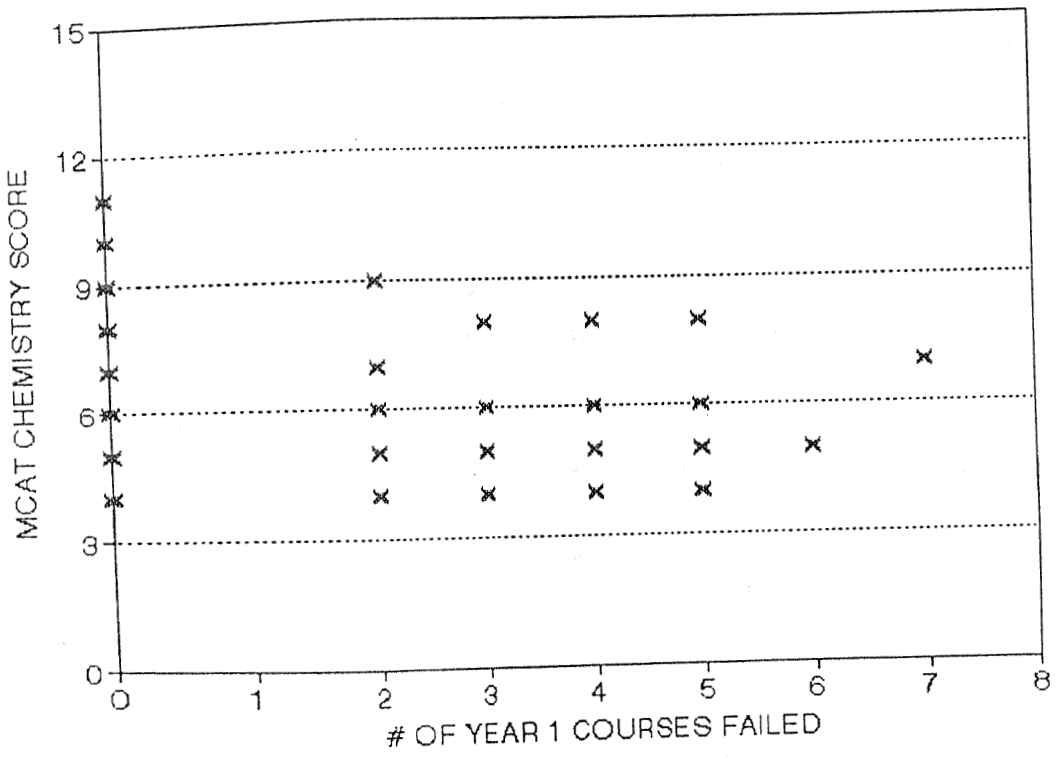


Figure 4. Scattergram of correlation of number of failures and physics subtest scores.

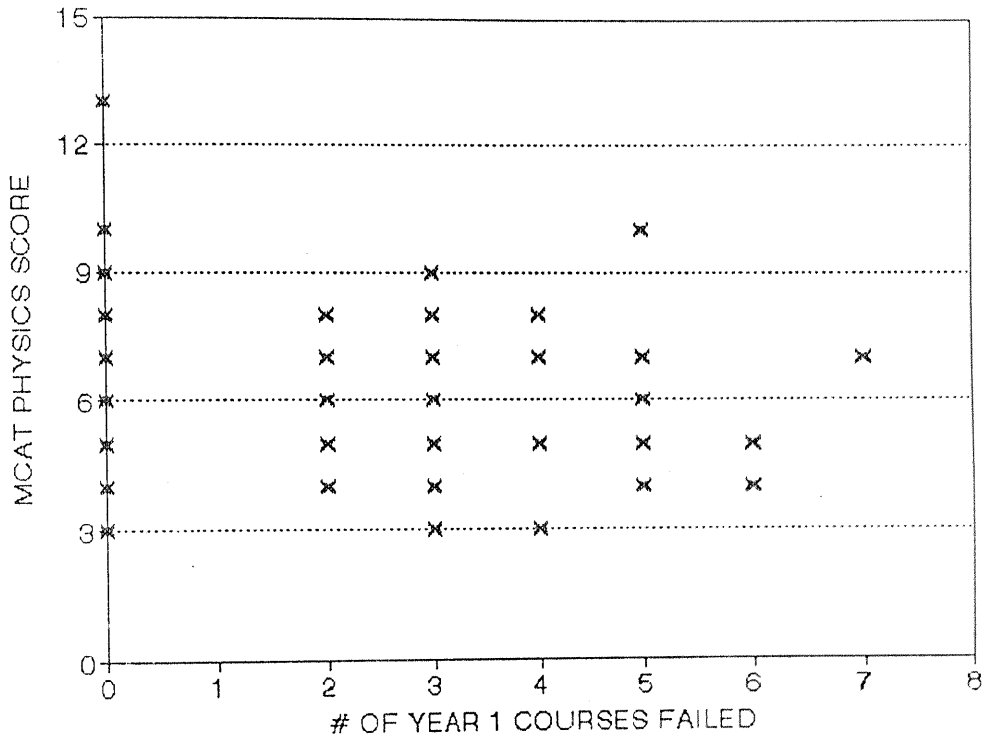


Figure 5. Scattergram of correlation of number of failures and science problems subtest scores.

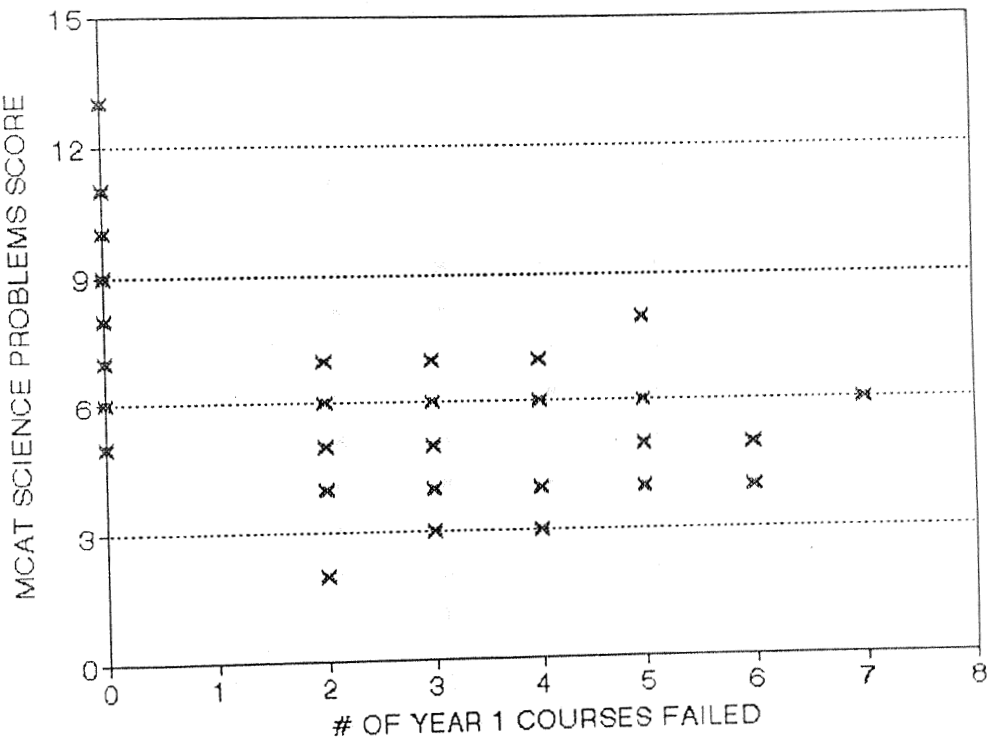


Figure 6. Scattergram of correlation of number of failures and reading subtest scores.

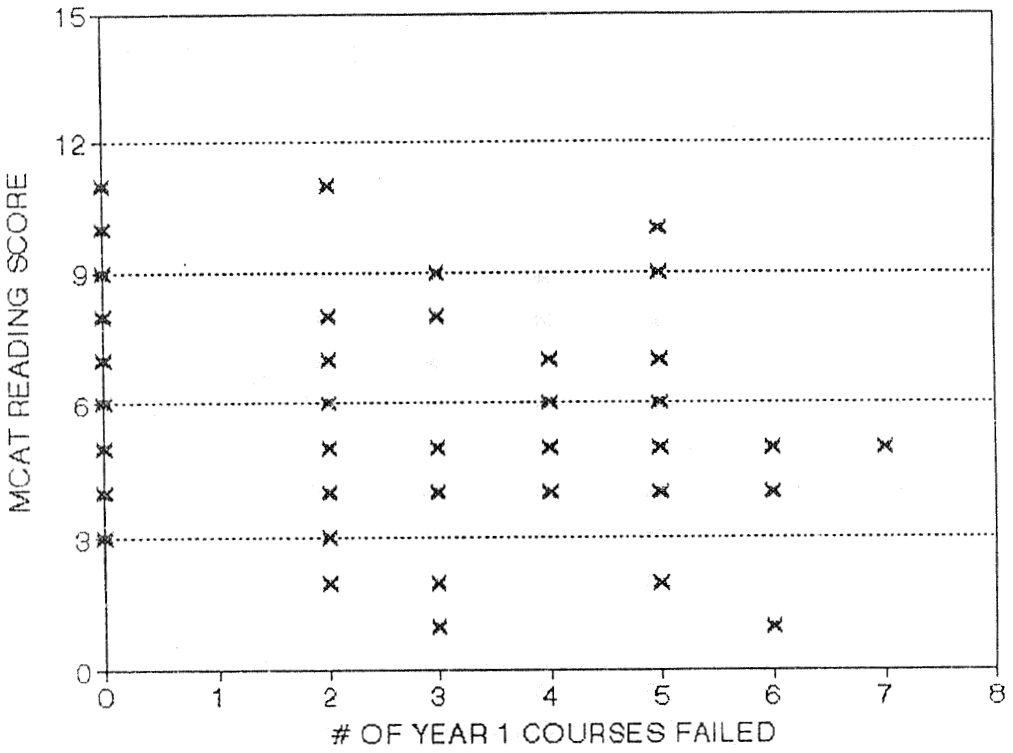


Figure 7. Scattergram of correlation of number of failures and quantitative subtest scores.

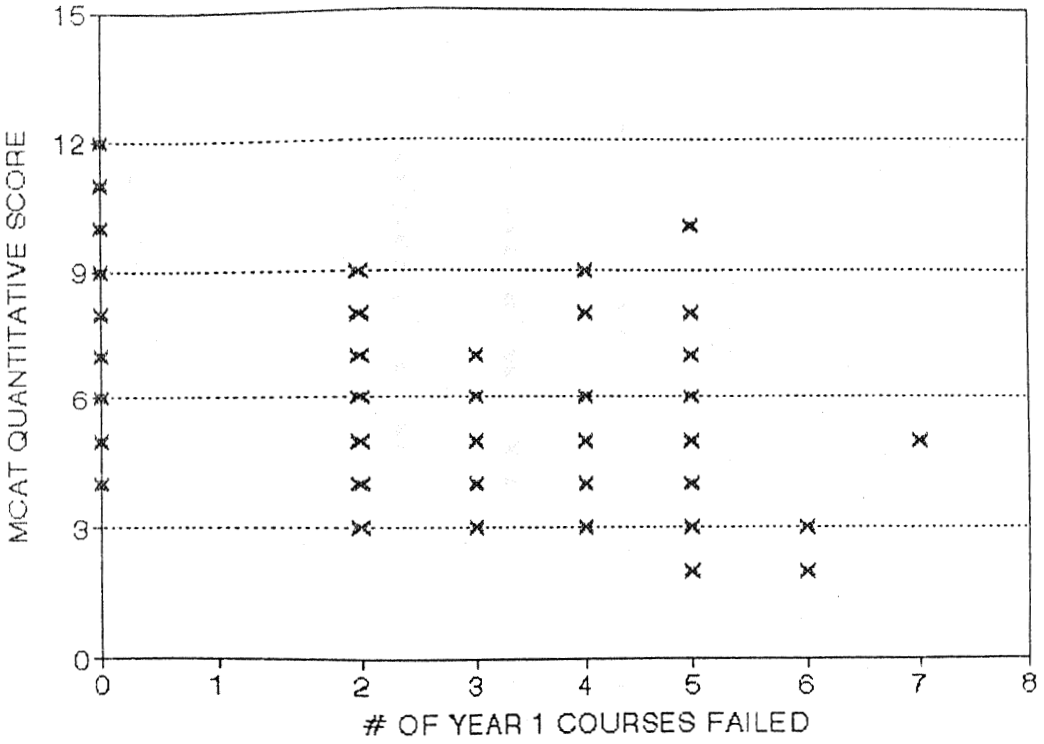


Figure 8. Scattergram of correlation of number of failures and undergraduate cumulative GPA.

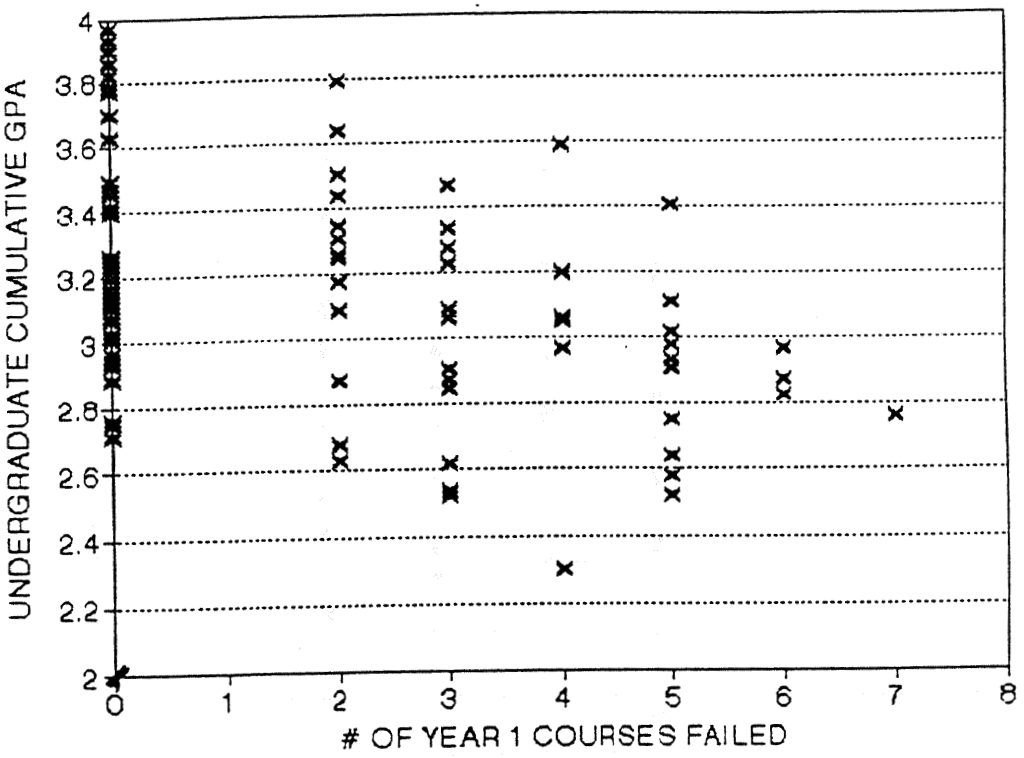
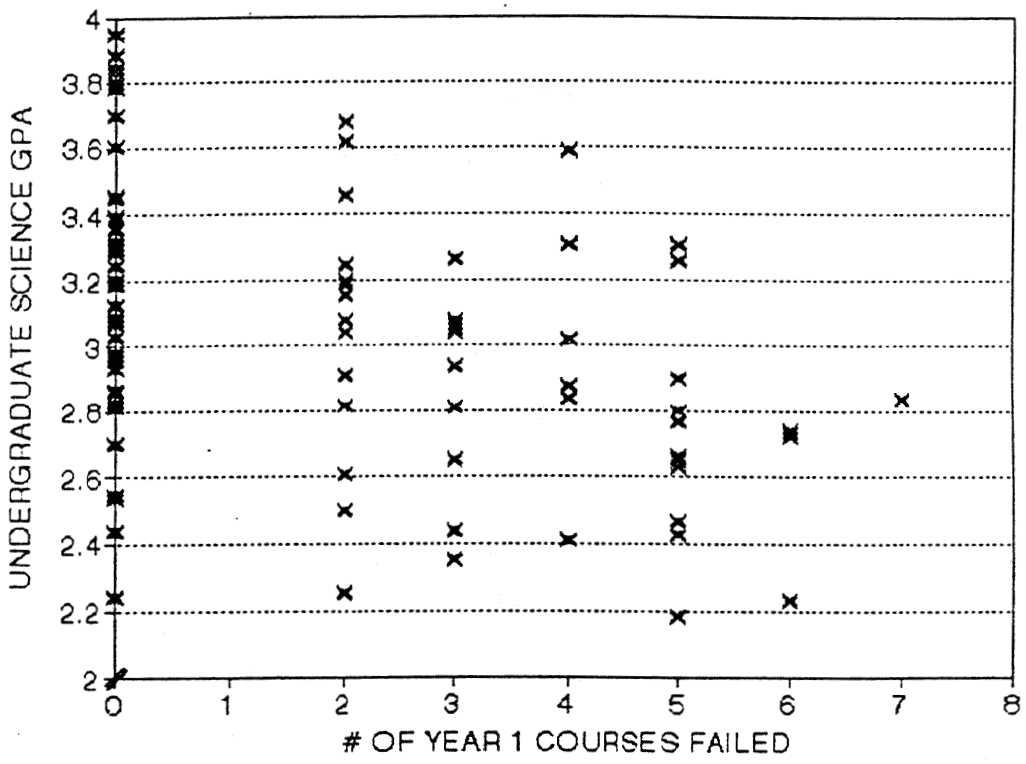


Figure 9. Scattergram of correlation of number of failures and undergraduate science GPA.



Coefficients of determination ranged from .13 to .25, indicating that 13 to 25 percent of the variability in number of course failures could be attributed to the MCAT subtest scores. These results are also in Table 5.

The correlation coefficients between undergraduate cumulative GPA and undergraduate science GPA and number of course failures were -.426 and -.425 respectively. The coefficients of determination were .181 indicating that 18.1 percent of the variability in number of course failures could be attributed to undergraduate cumulative GPA or undergraduate science GPA. These results are also in Table 5.

The critical value of r for a sample size of 100 (df=98) is .257 at $p<.01$. The absolute values of the correlation coefficients were all greater than .257 and were thus significant at the .01 level. Therefore, these observed values were unlikely to be the result of chance.

These findings supported the rejection of the null hypothesis that stated there was not a correlation between the number of course failures during the first year preclinical curriculum and each of the MCAT

Table 5

Correlations and Coefficients of Determination of Course Failures and Admission Variables

Admission Variables	*r*	r^2
Biology	-.493*	.243
Chemistry	-.500*	.250
Pbysics	-.361*	.130
Science Problems	-.482*	.232
Reading	-.458*	.210
Quantitative	-.447*	.200
Cumulative GPA	-.426*	.181
Science GPA	-.425*	.181

*df=98 (alpha=.01)*r*(98)=.257

subtests, the undergraduate cumulative GPA, and the undergraduate science GPA.

Null Hypothesis Two

The scattergrams in Figures 10 through 17 illustrate the linear relationships between each of the independent variables and the first year GPA. These plots revealed each relationship to have a positive slope meaning that as one variable increased the other variable also increased.

The correlation coefficients between MCAT scores and the first year GPA ranged from .381 to .555. Coefficients of determination ranged from .145 to .308, indicating that 14.5 to 30.8 percent of the variability in first year GPA could be attributed to the MCAT subtest scores. These results are shown in Table 6.

The correlation coefficients between the undergraduate cumulative GPA and undergraduate science GPA and first year GPA were .405 and .420 respectively. The coefficients of determination were .164 and .176, indicating that 16.4 percent of the variability in first year GPA could be attributed to undergraduate cumulative GPA and about 17.6 percent to the undergraduate science GPA. These results are also shown in Table 6.

Figure 10. Scattergram of correlation of first year GPA and biology subtest scores.

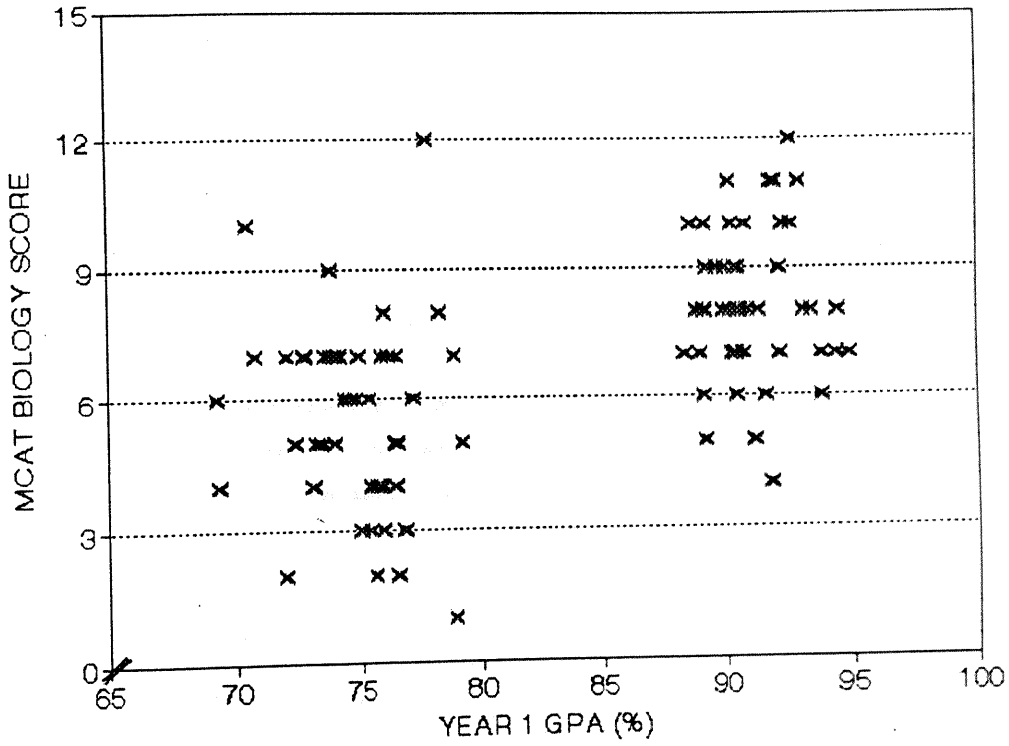


Figure 11. Scattergram of correlation of first year GPA and chemistry subtest scores.

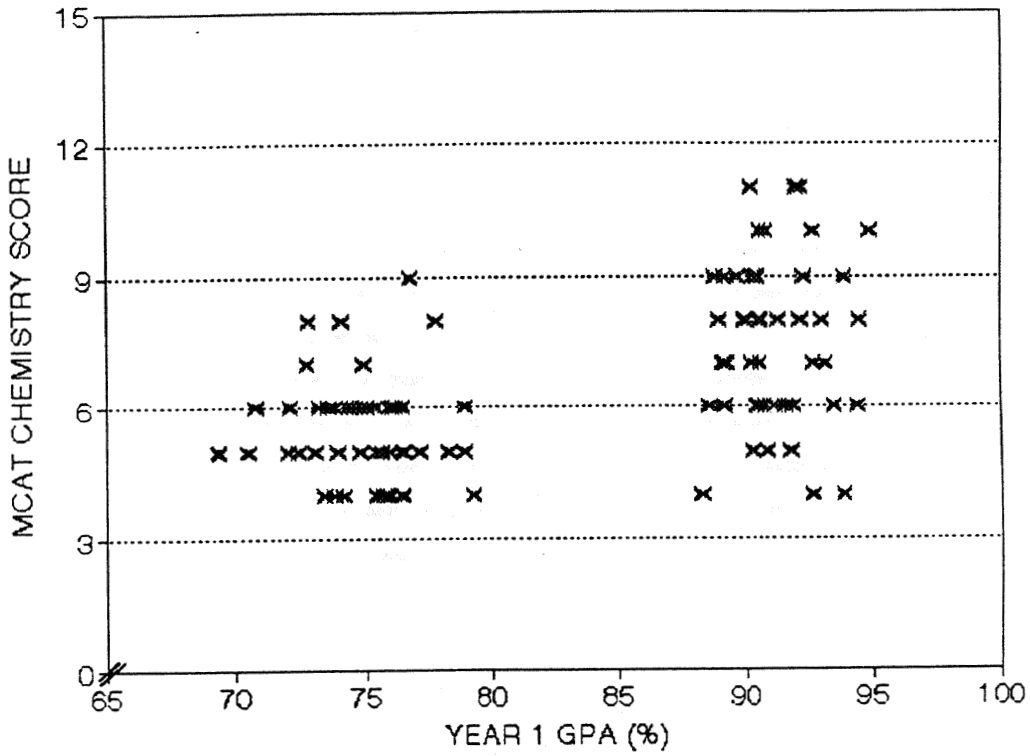


Figure 12. Scattergram of correlation of first year GPA and physics subtest scores.

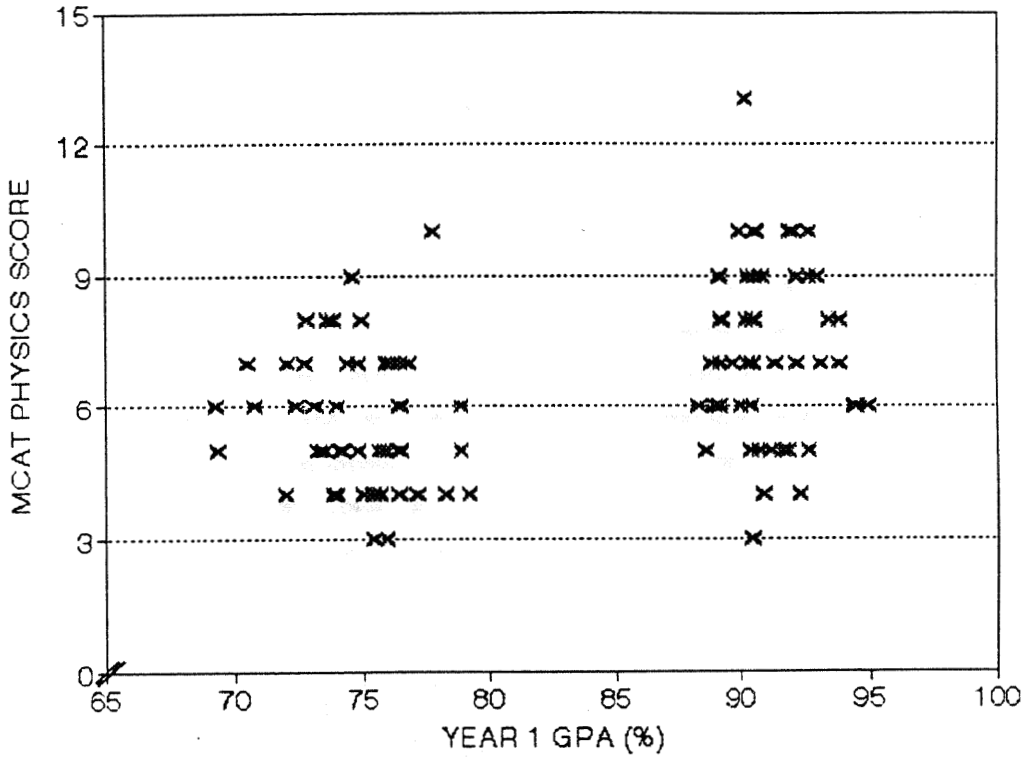


Figure 13. Scattergram of correlation of first year GPA and science problems subtest scores.

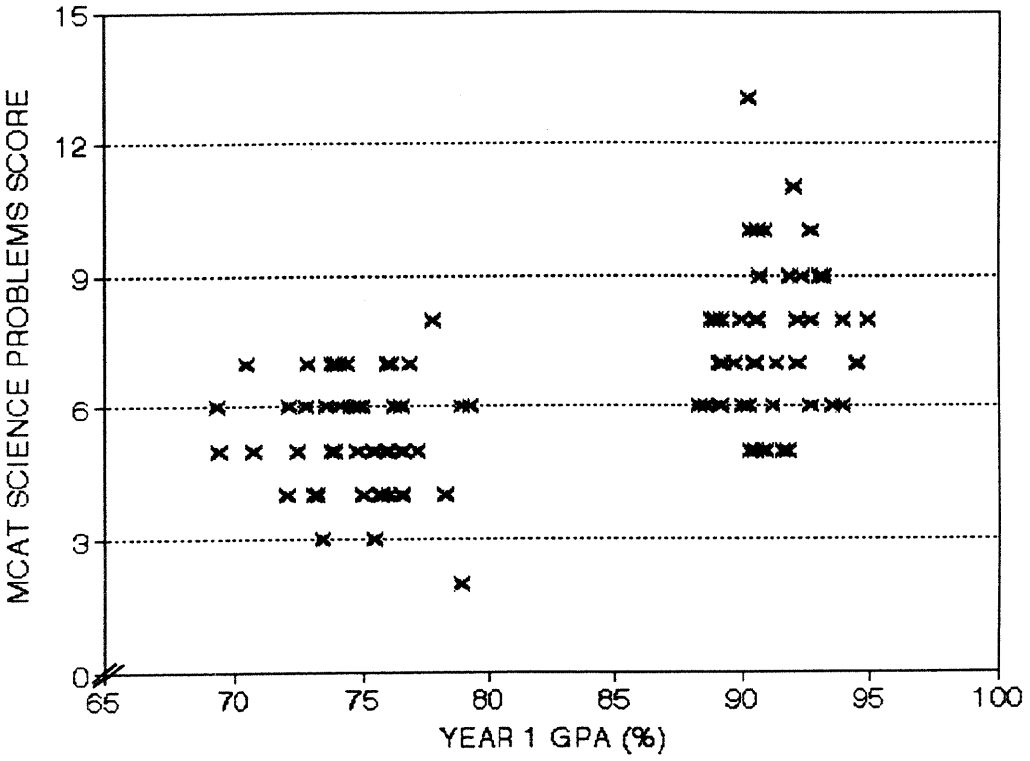


Figure 14. Scattergram of correlation of first year GPA and reading subtest scores.

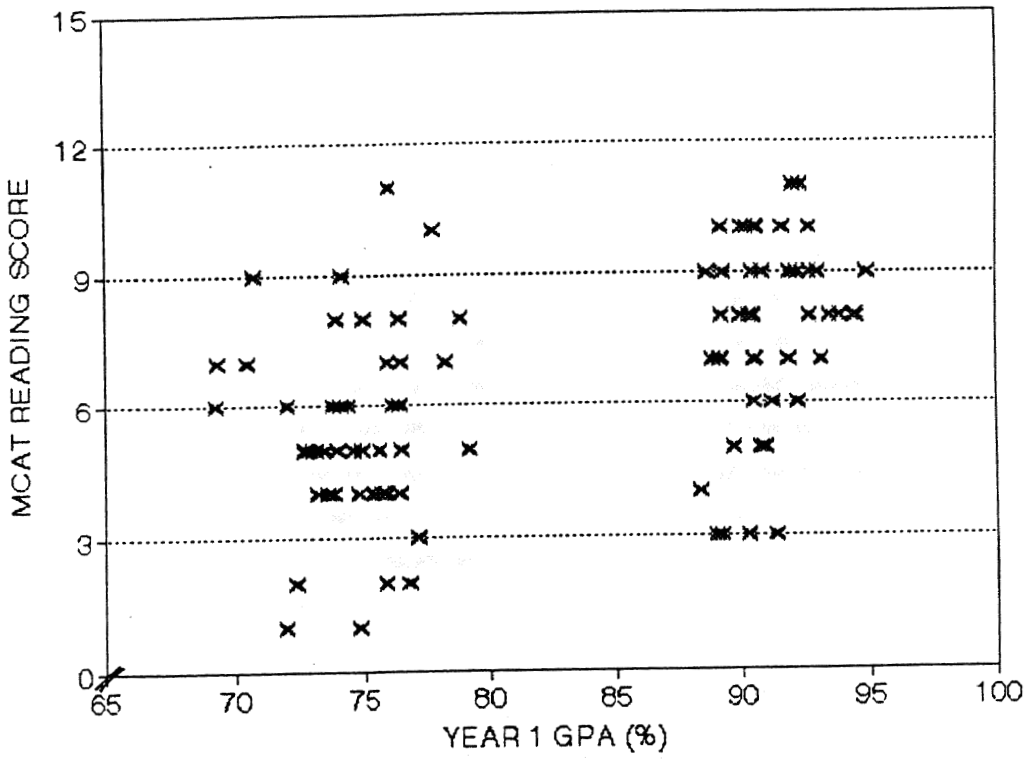


Figure 15. Scattergram of correlation of first year GPA and quantitative subtest scores.

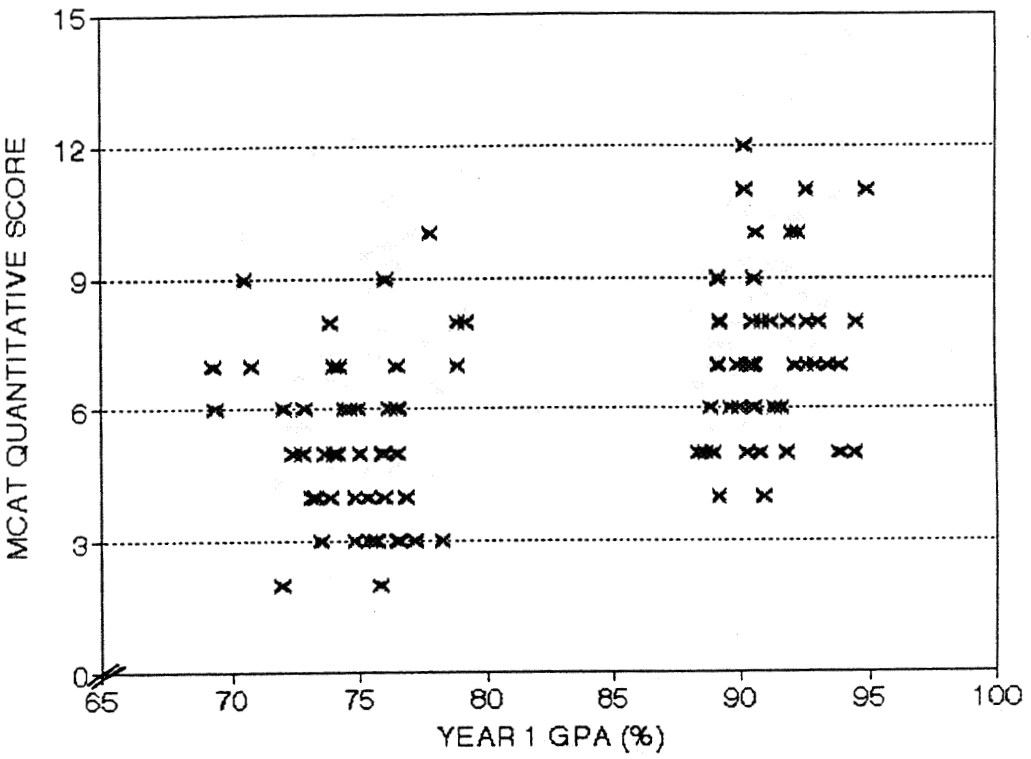


Figure 16. Scattergram of correlation of first year GPA and undergraduate cumulative GPA.

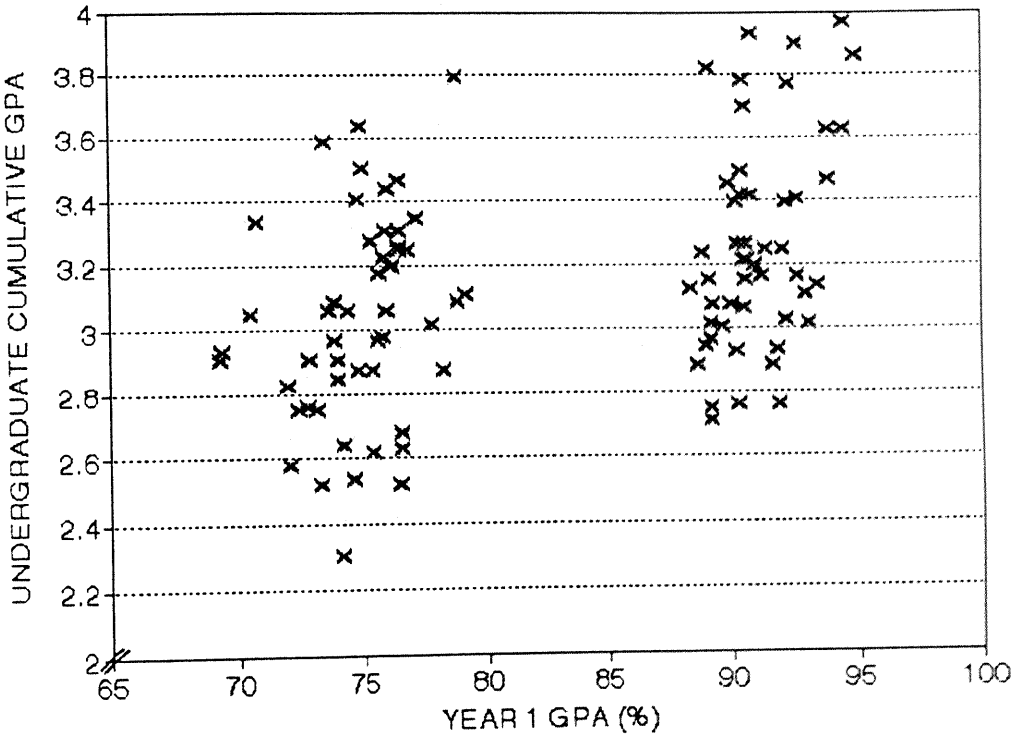


Figure 17. Scattergram of correlation of first year GPA and undergraduate science GPA.

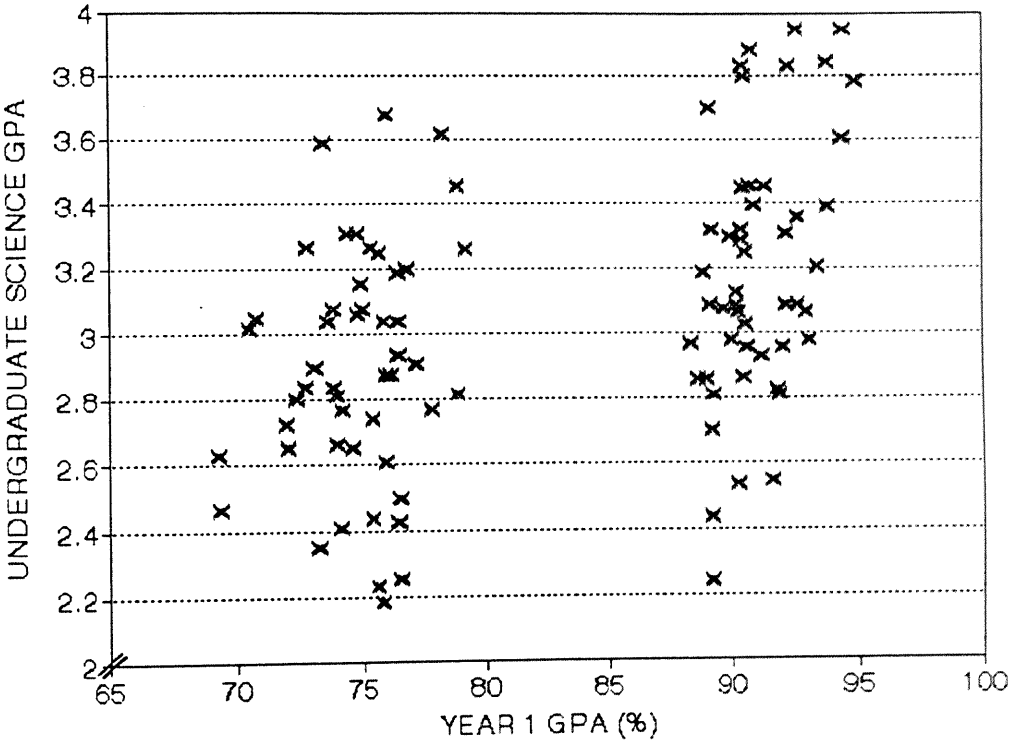


Table 6

Correlations and Coefficients of Determination of First Year GPA and Admission Variables

Admission Variables	r	r^2
Biology	.528*	.279
Chemistry	.541*	.293
Pbysics	.381*	.145
Science Problems	.555*	.308
Reading	.469*	.220
Quantitative	.475*	.226
Cumulative GPA	.405*	.164
Science GPA	.420*	.176

*df=98 (alpha=.01)$r(98)=.257$

The critical value of r for a sample size of 100 (df=98) is .257 at $p<.01$. The observed values of the correlation coefficients were all greater than .257 and were thus significant at the .01 level. Therefore, these observed values were unlikely to be the result of chance.

These findings supported the rejection of the null hypothesis that stated there is no correlation between the first year GPA and each of the MCAT subtests, the undergraduate cumulative GPA, and the undergraduate science GPA.

Summary

In summary, the analysis of the data in this study supported the rejection of the two null hypotheses. The next chapter will summarize and discuss the findings of this study.

Chapter 5

SUMMARY, CONCLUSIONS, DISCUSSION, RECOMMENDATIONS, AND IMPLICATIONS

Introduction

This chapter presents a summary of the findings of the study, the conclusions that can be drawn from the findings, comparisons of the findings of this study to the findings reported in the review of the literature, implications of the study, and recommendations for further study.

Summary and Conclusions

Results from the correlation analyses between number of course failures and the eight admission variables demonstrated eight significant correlations. These significant correlations ranged from -.361 to -.500. Except for chemistry, which would be considered a moderate correlation, the rest of the correlations would be considered low. Individually, these eight admission variables would be of limited value in predicting the number of course failures during the preclinical curriculum.

Since these correlations were low the coefficients of determination were also low. The admissions

variables could explain at the most only 25 percent of the variability in course failures. This meant that at least 75 percent of the variability was due to other factors.

Results from the correlation analyses between the eight admission variables and the first year GPA were not much different than the relationships shown with the number of course failures. All eight correlations were shown to be statistically significant. These positive correlations were primarily in the low range with biology, chemistry and science problem subtests showing moderate correlations. Again as with the course failures, individually these eight admission variables had limited value in the prediction of the first year GPA.

The coefficients of determination for these relationships were also low. The admission variables could explain at the most only 30.8 percent of the variability in the first year GPA. This meant that at least 69.2 percent of the variability was due to other factors.

The research question for this study was: Are there common admission characteristics among students who have academic difficulties in the first year

preclinical curriculum of an osteopathic medical school? The findings of this study answered this question in two areas.

First, the correlations between the number of course failures during the first year preclinical curriculum and each of the MCAT subtests, the undergraduate GPA, and the undergraduate science GPA were all statistically significant at $p<.01$ for the sample. The probability was less than one in a hundred that the observed correlation values for the sample would have occurred by chance if the null hypothesis was true. The researcher was thus inclined to reject the null hypothesis and infer that in the population there was a correlation between the number of course failures during the first year preclinical curriculum and each MCAT subtest, the undergraduate cumulative GPA, and the undergraduate science GPA.

Second, the correlations between the first year GPA and each of the MCAT subtests, the undergraduate GPA, and the undergraduate science GPA were all statistically significant at $p<.01$ for the sample. The probability was less than one in a hundred that the observed correlation values for the sample would have occurred by chance if the null hypothesis was true. The researcher

was thus inclined to reject the null hypothesis and infer that in the population there was a correlation between the first year GPA and each MCAT subtest, the undergraduate cumulative GPA, and the undergraduate science GPA.

Comparisons

There are a number of comparisons that can be drawn to research cited in the review of literature. Although the mean sample size of the reviewed studies was 243, the mode sample size was 0-100 making this study comparable in size to a number of studies done previously.

Jones and Thomae-Forgues (1984) in their study noted a correlation of .41 between the undergraduate cumulative GPA and the first year medical school GPA. This was almost identical to this study's correlation of .405.

Bridgham (1990) in a study of 93 students with MCAT scores less than eight found a correlation of -.44 between undergraduate overall GPA and number of failures during the first year. This was the best single predictor of number of failures. In this study, where the majority of the MCAT score means were below eight,

the same correlation was -.426. Chemistry though was the best single predictor with a correlation of -.500.

Hall and Bailey (1992) studied five classes of medical students with a mean science GPA of 3.32. When correlating first year grades with MCAT subtest scores, the correlations ranged from .334 to .469. In this study, where the students' mean science GPA was 3.20, the same correlations ranged from .381 to .555. Hall and Bailey also correlated undergraduate science GPA with first year grades. These correlations ranged from .221 to .357. The same correlation in this study was .420.

Jones and Vanyur found the strongest correlations with first year grades were MCAT scores in the science areas of assessment. This was confirmed in this study with the MCAT subtests of biology, chemistry and science problems having the highest correlations.

In all the literature reviewed, MCAT scores had the capacity to explain from 11 to 22 percent of the variability of first year grades. In this study, these same scores accounted for 14.5 to 30.8 percent of the variability in first year grades.

Several studies spoke to the level of MCAT scores at which academic difficulties were encountered.

Mitchell (1987), in a survey of admission officers, found the mean response for the bottom of the acceptable MCAT range was seven. Jones and Vanyur (1984) found the probability of academic difficulty increased systematically for students receiving MCAT scores below eight. Jones and Mitchell (1986) found that both black and white students with scores below eight had an increasing probability of difficulty. In this study, it appeared that students with MCAT scores below six had an increasing probability of academic difficulty.

The results from this study, when viewed overall in comparison with the reviewed literature, did not vary significantly from previous studies. The osteopathic medical school population did not appear to differ significantly from the non-osteopathic medical school population.

Discussion and Implications

Admissions committees of medical schools will have tougher decisions ahead as the applicant pool continues on its upward swing. This study can only make inferences to the College of Osteopathic Medicine and Surgery at the University of Osteopathic Medicine and Health Sciences from which this sample was derived. Any other generalizations must be made with extreme care.

Several limitations may have affected the results of this study. The five classes from which the sample was chosen were classes that were admitted during a period of low applicant pools and the average level of admission variables for admitted students was lower. Currently, the medical school applicant pool is very high and the admission variable averages have increased.

This study would also have been strengthened if complete admission data had been available for all students with two or more course failures. These documentation omissions resulted in a smaller sample size.

The internal validity threats of maturation and history were unknown factors in the results. Interviews with students could have aided in determining the role of these internal and external influences on the students' performances.

The science problems and reading subtests and the undergraduate science GPA show relationships but not as strong as predicted by administrators and faculty of the osteopathic medical school. Along with the science problems subtest, more attention could be given to the chemistry and biology subtests. Early intervention

programs should be designed for those students with MCAT scores consistently below six whom also have lower undergraduate cumulative and science GPA's (less than 3.0).

As shown by this study and others, individual MCAT scores and GPA's account for a relatively low percentage of the variability of performance measures during the preclinical curriculum. The factors that explain the other 70-80 percent of the variability are unknown at the present. Each student may have a unique set of contributing variables. Some of these variables, such as motivation and parental influence, may not be measurable.

In terms of admission decisions to medical schools, a combination of admission variables may account for a higher percentage of the variability of performance measures. These may not only be combinations of MCAT scores and GPA's, but could also include interview scores, number of undergraduate institutions attended, length of time for completion of degree, etc. In reality, MCAT scores and GPA's cannot be the only determining factors in admission decisions. These are just two components that contribute information to a complete applicant profile.

Another set of factors may need to be analyzed to identify already admitted students who may need added assistance in order to successfully complete the preclinical curriculum. These factors may include the student's age, the length of time it has been since completion of the undergraduate degree, the student's temperament, the student's learning style, etc. It needs to be determined how the student may fit or not fit with the design and intensity of the curriculum and the modes of teaching the content of the curriculum.

Recommendations

This study was just the first and narrow step for a midwestern osteopathic college in its process of studying student performance. This research contributes to a limited body of research on the relationship of admission criteria to academic performance at osteopathic medical schools.

Future research needs to expand the variables for study. These variables could include age of students, number of undergraduate institutions attended, length of time for completion of undergraduate degree, length of time since completion of degree, the student's temperament and learning style, etc. The medical

student population appears to be getting older and different variables may need to be researched.

Individual institutions should continue to do their own studies. Within these studies they should not only look at traditional predictors, but should also look at variables that are unique to their applicant pool and their institutions.

The students are only part of the equation. Medical schools should also research factors that have been identified by other higher education programs as contributing to the level of success of students. These include the campus and classroom environment, curriculum and course design, teaching styles and modes of presentation of material, meaningful faculty-student interactions, and appropriate support services and learning resources.

Individual institutions should have the ability to identify why their students are having difficulties. The number of students experiencing difficulties can then be reduced either through changes in admission requirements or changes within various factors within the school. If medical schools can accomplish this they should not have to worry about why they do not fit into national trends.

National studies should also begin looking at additional variables. These studies can still play an important role in providing background information and impetus to individual institutional studies.

References

Arnold, L., & Mares, K. (1985). Analysis of exit interviews with students who left the combined BA-MD degree program of the UMKC School of Medicine (Report No. HE 018 728). Kansas City, MO: University of Missouri Kansas City, Research in Medical Education Group. (ERIC Document Reproduction Service No. ED 261 629)

Bridgham, R. G. (1990, April). Improved prediction, for medical students with low MCATS, of indices of preclinical performance. Paper presented at the annual meeting of the American Educational Research Association, Boston, MA.

Colliver, J. A., Verhulst, S. J., & Williams, R. G. (1989). Using a standardized-patient examination to establish the predictive validity of the MCAT and undergraduate GPA as admissions criteria. Academic Medicine, 64, 482-484.

Daugherty, S., Eckenfels, E., & Schmidt, J. (1990). Admission committee dissent as a predictor of problems in medical school. Academic Medicine, 65, S1-S2.

Hall, F. R., & Bailey, B. A. (1992). Correlating students' undergraduate science GPA's, their MCAT scores, and the academic caliber of their undergraduate colleges with their first-year academic performances across five classes at Dartmouth Medical School. The Advisor, 12, 3-6.

Hart, M. E., Payne, D. A., & Lewis, L. A. (1981). Prediction of basic science learning outcomes with cognitive style and traditional admissions criteria. Journal of Medical Education, 56, 137-139.

Hendren, R. L. (1988). Predicting success and failure of medical students at risk for dismissal. Journal of Medical Education, 63, 596-602.

Inglehart, M., & Brown, D. (1990). Professional identity and academic achievement-Considerations for the admissions process. Academic Medicine, 65, S3-S4.

Jackson, E. W., & Dawson-Saunders, B. (1987). History of not completing courses as predictor of academic difficulty among first-year students. Journal of Medical Education, 62, 880-885.

Jackson, J. R., & Brooks, C. M. (1985). Relationships among the MCAT Reading Subtest, Nelson-Denny Reading Test, and medical school achievement. Journal of Medical Education, 60, 478-480.

Jackson, J. R., Brooks, C. M., Brown, S., & Scott, C.W. (1989). Academic performance of reapplicants to a medical school. Academic Medicine, 64, 219-220.

Jones, R. F., & Mitchell, K. (1986, April). Racial/ethnic differences in the predictive validity of MCAT scores. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Jones, R. F., & Thomae-Forgues, M. (1984). Validity of the MCAT in predicting performance in the first two years of medical school. Journal of Medical Education, 59, 455-464.

Jones, R. F., & Vanyur, S. (1984). MCAT scores and student progress in medical school. Journal of Medical Education, 59, 527-531.

Keill, S. L., & Willer, B. (1985). Detection of psychiatrically at-risk applicants in the medical school admission process. Journal of Medical Education, 60, 800-802.

Kerbeshian, L. A. (1989). Predicting and fostering success of American Indians in medical school. Academic Medicine, 64, 396-400.

Koenig, J. A. (1992). Comparison of medical school performances and career plans of students with broad and with science-focused premedical preparation. The Advisor, 12, 7-13.

Mitchell, K. J. (1987). Use of MCAT data in selecting students for admission to medical school. Journal of Medical Education, 62, 871-879.

Mitchell, K. J. (1990). Traditional predictors of performance in medical school. Academic Medicine, 65, 149-158.

New Medical College Admission Test (MCAT) Interpretive Manual. (1977). USA: Association of American Medical Colleges.

Solander, L. (1978). Modeling student academic performance: Predicting "success" or "trouble" in a professional pharmacy program. American Journal of Pharmacy Education, 42, 326-329.

Strayhorn, G., & Frierson, H. (1989). Assessing correlations between black and white students' perceptions of the medical school learning environment, their academic performances, and their well-being. Academic Medicine, 64, 468-473.

Walker, J. D., Killip, D. E., & Fuller, J. L. (1985). The significance of the admission interview in predicting students' performance in dental school. Journal of Medical Education, 60, 569-571.

Zeleznik, C., Hojat, M., & Veloski, J. (1983). Baccalaureate preparation for medical school: Does type of degree make a difference? Journal of Medical Education, 58, 26-33.